ANCIENT CHINESE OBSERVATIONS OF
PHYSICAL PHENOMENA ATTENDING SOLAR ECLIPSES

P. K. WANG and G. L. SISCOE

Department of Atmospheric Sciences, University of California, Los Angeles, CA 90024, U.S.A.

Abstract. The realization that solar activity probably undergoes changes in qualitative character on time scales greater than the 11 or 22 year cycle but short compared to the duration of recorded history gives renewed importance to historical documents describing the state of solar activity. Modern eclipse observation reveal the presence of solar activity through the appearance of coronal structures and prominences. It has been widely remarked that eclipse records prior to the 18th century are uniformly silent on these conspicuous solar eclipse features, raising the possibility, however unlikely, that a change in solar activity has occurred which rendered them only recently noticeable. We present here material from ancient Chinese sources, primarily astrological, that describe phenomena attending solar eclipses that are almost certainly coronal structures and prominences. Thus, these aspects of the present character of solar activity have apparently occurred at other times in history, if not continuously.

1. Introduction

The ancient Chinese observations on solar eclipse can be traced back to more than 4000 years ago. The earliest record was that written in Shu-Chin (literally, The Book) (see Appendix). A royal astronomer who failed to predict the solar eclipse at that time was killed. According to Chen (1955) this event occurred at October 22, 2137 B.C. which was the time of Hsia dynasty (2183–1751 B.C.) in China (another Calenderist, Liu (1945), dated it on October 23, 2110 B.C.). Since then there were continuous record on solar eclipses in Chinese official histories of all dynasties. Chu (1933, 1934) compiled 916 occurrences of solar eclipses from ancient Chinese literature from 2137 B.C.–1785 A.D.

The most important reason for ancient astronomers in China to record solar eclipses was to check the accuracy of calendar systems. There were a number of official astronomers who were discharged when their calendar systems failed to predict either a solar or a lunar eclipse. Since a solar eclipse is such a spectacular, heavenly phenomenon, people tended to link it to the fate of political systems, especially to the stability of the throne of emperors. On the occasion of an eclipse, an emperor was supposed to think what wrong or evil he had done to the people and then to correct it in an appropriate way. Of course this was no more than a gesture. As Shun Chin (313–238 B.C.) pointed out, all rites about rescuing the eclipsed Sun, praying for rain, or devining to make important decisions, were not really in the sense that these would work, but were no more than formality.

The way in which solar eclipses were noted in the official records was very simple. For example, the above mentioned 2137 B.C. eclipse was recorded as “At the 1st day (the new moon day) in late fall (i.e. the 8th month), the Sun and Moon could not live peacefully together in the sky”, which was followed by a description of what people did during the eclipse. A more typical way of recording a solar eclipse is
exemplified by simply "In the 17th year of Duke Chao, summer, 6th month, the day Chia-Shu, new moon. Solar eclipse (Jih-Shih)". This type of recording of a solar eclipse was followed throughout the official historical records. Thus in most cases no descriptions of any physical phenomena observed during solar eclipses were given.

Solar eclipse records occasionally occur in poems. Even here there is little concerning attendant phenomena. In an ancient book The Poems which was edited by Confucius, a solar eclipse is mentioned: "In the 10th month, the new moon day Shin-Mao, there is a solar eclipse". In Section 3 lightning and thunder are described which do not seem to relate to the eclipse. Another poem on a solar eclipse by Mei Shen-Yu (1002–1060 A.D.) reads "Suddenly a monster is coming to cover the Sun, making it a piece of stupid copper". He went on to scorn the spirit in the Sun – a 3-legged crow, which is a common designation of Sun spots, and thus left no message concerning the appearance of the eclipse.

A similar attitude characterized western historians and chroniclers who gave few details about the visual phenomena accompanying a solar eclipse. The absence of ancient descriptions of the visual scene associated with total solar eclipses, such as coronae and prominences which are so evident and so generally described in recent eclipse events, led Eddy (1976) to suspect that in ancient solar eclipses there might not have been any coronae or prominences at all. He proposed that this may indicate a behavior of the ancient Sun, in which solar activity was significantly attenuated.

Motivated by this important conjecture, we began an independent search of the ancient Chinese literature. We found some material in which visual phenomena which occurred during total solar eclipses are, in fact, described. Most of this material to our knowledge has not been brought to the attention of solar researchers.

2. Dated Material

(1) There is one record (Liu, 1942) of a solar eclipse engraved on a piece of oracle bone of Shang dynasty (1751–1111 B.C.) which contains an interesting description. This record is mentioned by Needham (1959). It reads as follows: The day Yee-Mao, dawn, fog. Three flames ate the Sun. Big star.

This is almost certainly a description of a total solar eclipse. From the context, the eyewitness of this event saw three flame-like things beside but attached to the eclipsed Sun, and he construed that these were responsible for the eclipse. He also saw a bright star appear, for which a total eclipse would have been necessary.

While the description clearly records the existence of luminous gas protruding from the Sun, it is unclear whether this was the solar corona or prominences. Liu (1944) and Chen (1955) favor the second possibility. However the solar corona can also resemble flames when long streamers extend outward. But whatever they were, they disclose the presence of some kind of solar activity at that time.

The big star mentioned in the inscription is another problem. Liu (1944) said it might be Mercury while Chen (1955) considered that unlikely arguing that Mercury would be too close to the Sun to be seen. It might also have been Venus or even Vega